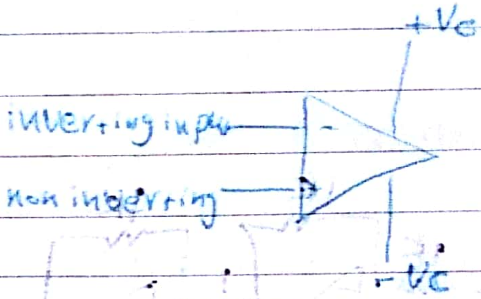
EE463

Comparator:-

أنواع التغذية



+Vc
inverting input
non inverting
-Vc

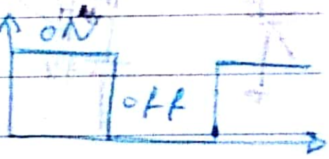
Singl supply

Dual supply

الأفضل

single supply : LM 324 for on off

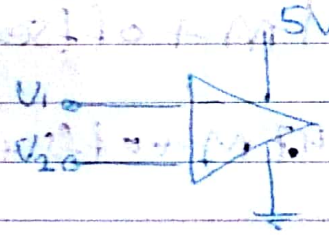
تكون 30v أو 32 v



الفرق بين V_1 , V_c

if $V_2 > V_1 \Rightarrow V_{out} = 5V$

$V_1 > V_2 \Rightarrow V_{out} = -0V$

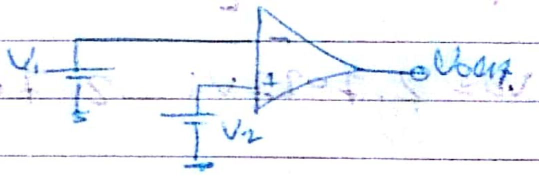


at normal operation amp :-

if $V_1 = V_2 \Rightarrow V_o = 0$

$V_1 > V_2$ $V_{out} = -20V$

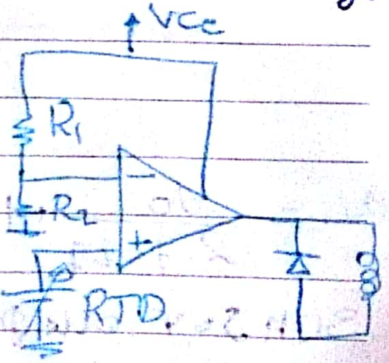
$V_2 > V_1$ $V_{out} = 20V$.



Ex:- Design a ckt that activate a Fan when the temp is axcessed 45°C using RTD which sensty is 8.5 mV/°C , $R_1 = 1K\Omega$, $V_{cc} = 5V$

$V = 5 \times \frac{R_2}{R_1+R_2} \Rightarrow R_2 =$

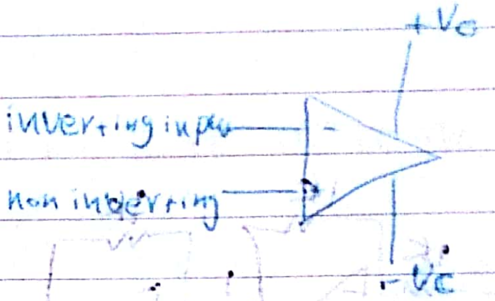
if $V_{RTD} > 0.3825$ $V_o = 5V$
$<$ $V_o = 0$



Vcc
R_1
R_2
RTD

EE 463

Comparator :-


+Vc
inverting input
non inverting
-Vc

أنواع التغذية:

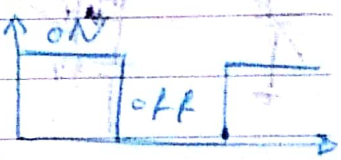
Singl supply

Dual supply

الأفضل

Single supply : LM 324 for on-off

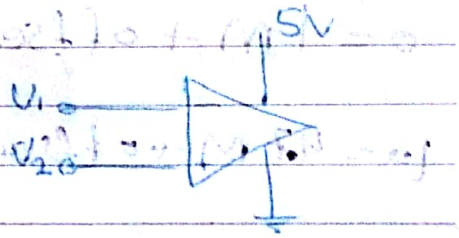
تكون 32V أو 30V



V: Vc الفرق بين

if $V_2 > V_1 \Rightarrow V_{out} = 5V$

$V_1 > V_2 \Rightarrow V_{out} = -0V$

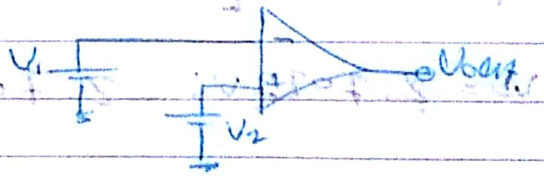


at normal operation amp :-

if $V_1 = V_2 \Rightarrow V_o = 0$

$V_1 > V_2$ $V_{out} = -20V$

$V_2 > V_1$ $V_{out} = 20V$.

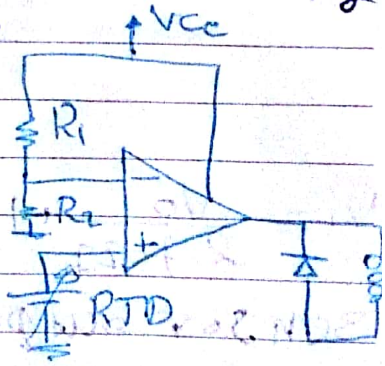


Ex:- Design a ckt that activate a Fan when the temp is axcessed 45c° using RTD which sensty is 8.5 μV/c° , $R_1 = 1K\Omega$, $V_{cc} = 5V$

$V = 5 \times \frac{R_2}{R_1 + R_2} \Rightarrow R_2 =$

if $V_{RTD} > 0.3825$ $V_o = 5V$

$<$ $V_o = 0$


Vcc
R_1
R_2
RTD

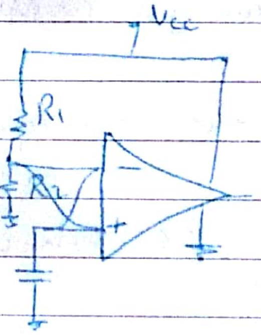
EE463

Ex:- Design a cct that activate a Heater when the temp is less than 20°C using RTD which sensitivity 8.5mV/c

Sol:-

at 20°C $V = 20 \times 8.5 = 0.17$

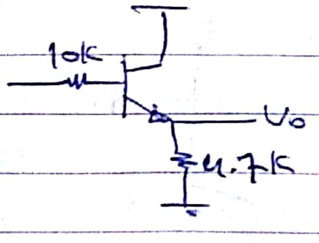
$R_1 = 1K\Omega$ $R_2 = 55K\Omega$

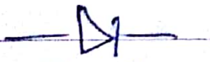


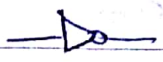
Regulator:-

7805 +5V 7812 (+12)
7905 (-5V). 7912 (-12V)

لما نعطيه 20v ياخد منه 5v فيحتاج إلى
Heat Sink لتبريد الطاقة.




BUFFer.


inveter.

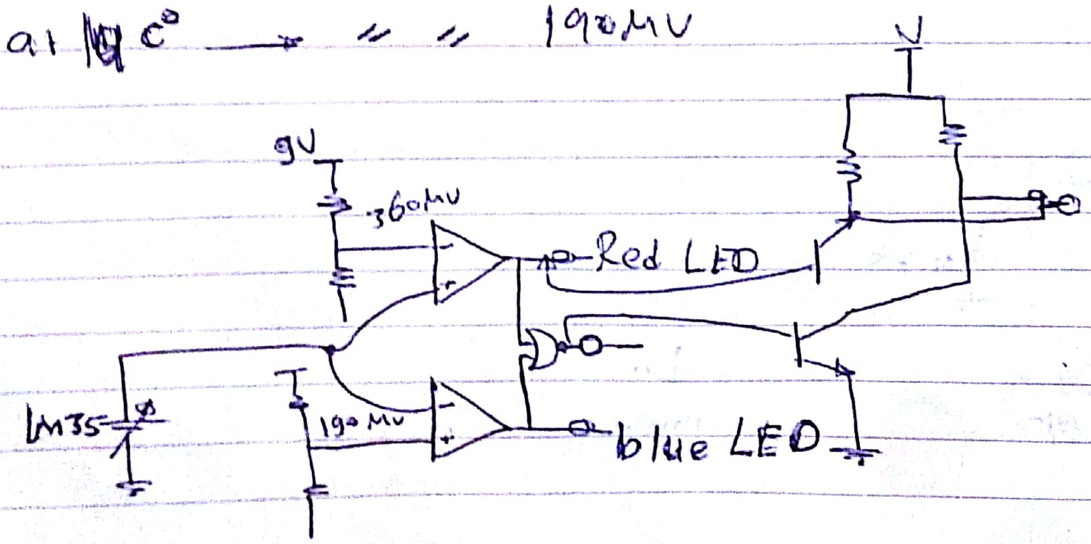
EE463

pull up and pull down → (Float) لمنع حالة الطفو

Ex:- design Control circt to turn on RED LED
when the temperture is More than 36? & turn on
Blue LED when tempeture is less than 19c°
and turn on Green LED when the temp is
between them [use LM35] 10mV/c°

at 36c° → sensor output = 360mV

at 19 c° → " " 190mV


V
9V
360mV
Red LED
LM35
190 mV
blue LED

EE463

* Filters:-

passive filter.

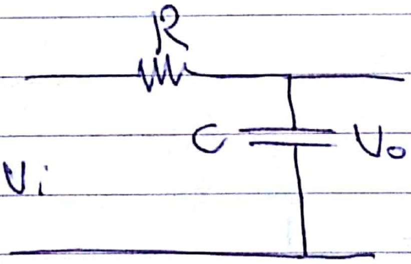
Ex:- low pass fliter (LPF)
high pass filter (HPF)
Band pass Filter (BPF)
Band Stop Filter (BSF)

low pass Rc Filter:-

because it's blocks high freq and passess low Freq

Critical freq or cutoff Freq:- is that freq for which that ratio of the output to the input voltage is approximately 0.707

$$f_c = \frac{1}{2\pi RC}$$



Ex:- A Measurment signal has a freq < 1kHz but there is unwated noise at about 1MHz. Design low pass Filter that attenuate the noise 1%. What is the effect on Measurment Signal at the Maximum of 1kHz

$$\frac{V_o}{V_i} = \frac{1}{\sqrt{1+\left(\frac{1M}{f_c}\right)^2}}$$

إشارة
تشويش

$$\frac{1}{100} = \frac{1}{\sqrt{1+\left(\frac{1M}{f_c}\right)^2}}$$

$$1+\left(\frac{1MHz}{f_c}\right)^2 = 10000$$

$$\left(\frac{1MHz}{f_c}\right)^2 = 9999$$

$$\frac{1MHz}{f_c} = \sqrt{9999} \Rightarrow f_c = 10.0005\ KHz$$

$$f_c = \frac{1}{2\pi RC}$$

let $C = 0.47\mu F$, $R = \frac{1}{2\pi f_c C}$

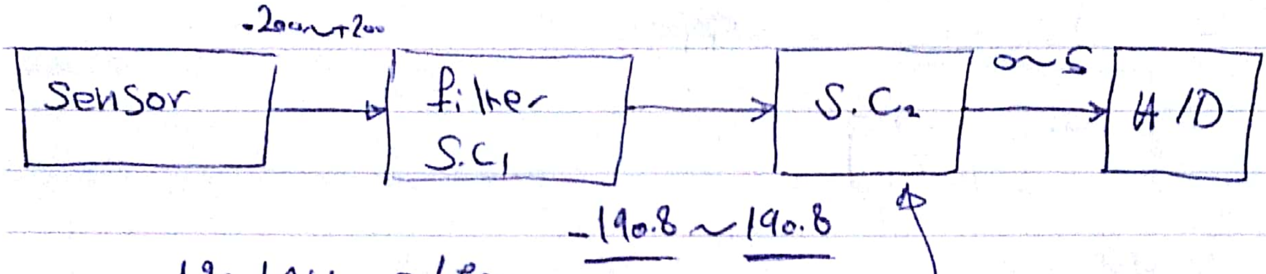
$R = 33.9\ \Omega$

let $C = 0.01\mu F \Rightarrow R = 1591\ \Omega$

المقاومة الموجودة في السوق 1500

$f_c = 10.61\ KHz$

EE 463


-200mv ~ 200mv
Sensor
filter
S.C₁
S.C₂
0 ~ 5
A/D
-190.8 ~ 190.8

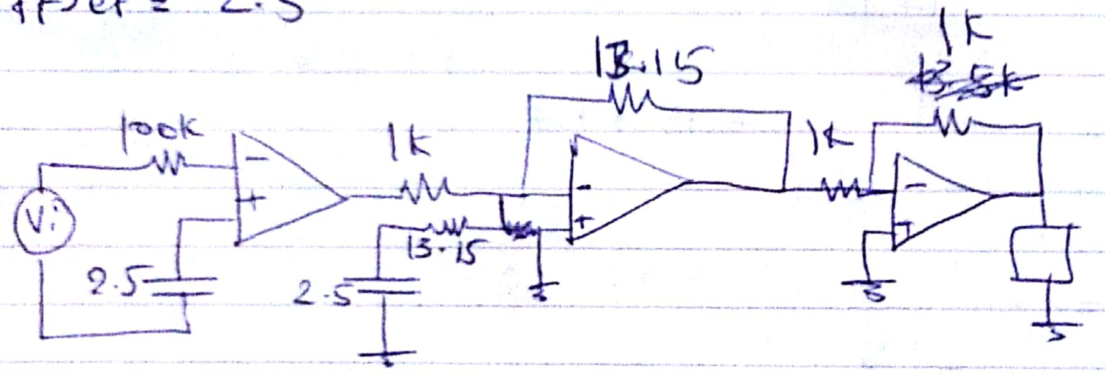
$0 = -190\,mV + offset$

$V_o = V_i\, 13.15 + 2.5$

$5 = 190\,mV \cdot M + offset$

$5 = 0.380M \Rightarrow M = 13.15M$

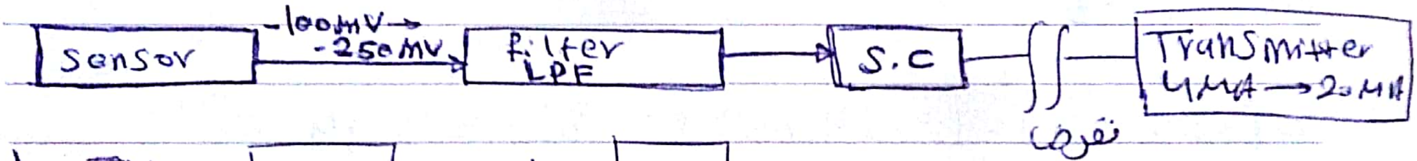
offset = 2.5

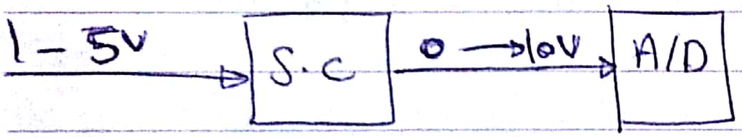

100k
Vi
2.5
1k
13.15
2.5
13.15
1k
1k
~~13.5k~~

EE463 21/11/2017

EX:- Design Signal Conditing circuits for the Sensor which range -100mW to +250mV & frequqny 5HZ and the noise signal → 20mV , frequcy 60HZ and attenuation → 30% for ADC (0 → 10) and we will tramitt the data up to 0.3 KM

Ans:-


Sensor
-100mV → -250mV
filter LPF
S.C
Transmitter 4mA → 20mA


1 – 5V
S.C
0 → 10V
A/D

$C = 0.1 \mu$

$$R = \frac{1}{2\pi \times 0.1 \times 10^{-6} \times 18.869} = 84.347\,K\Omega$$

$$\Rightarrow \frac{30}{100} = \frac{1}{\sqrt{(1) + \left(\frac{FN}{Fc}\right)^2}} \Longrightarrow fc = 18.869$$

$$\frac{V_o}{V_i} = \frac{1}{\sqrt{(1) + \left(\frac{fs}{Fc}\right)^2}} = \frac{V_o}{V_o} = \frac{1}{\sqrt{(1) + \left(\frac{5}{18.869}\right)^2}} = \boxed{\%96.66}$$

the new ~~sensto~~ sensor range after filtering

(-96.66 mV ~ +24.659 mV)

S.C to (1 → 5 V)

$$\frac{V_o}{V_i} = \frac{1}{\sqrt{1+\left[\frac{1KHz}{10.61}\right]^2}} = 0.9956$$

$= \% 99.56 \rightarrow$ معظم الاشارة وصلت

Ex:- Design S.C for ADC (0 → 5v) for sensor range (−200 ~ +200mV) $f_s = 5Hz$ Noise signal 20mV, $f_N = 50Hz$

$$\frac{5}{100} = \frac{1}{\sqrt{1+\left(\frac{50}{f_c}\right)^2}} = 2.5Hz$$

$$\frac{30}{100} = \frac{1}{\sqrt{1+\left(\frac{50}{f_c}\right)^2}} = 15.7\,Hz$$

$$\frac{V_o}{V_i} = \frac{1}{\sqrt{1+\left(\frac{5}{15.7}\right)^2}} = \%95.28$$

نفرض

$f_c = \frac{1}{2\pi RC}$, $\underline{C = 0.1 \mu F}$, $\underline{R = 101.3k}$

$$f_c = \frac{1}{2\pi 0.1 \times 10^{-6} \times 100 \times 10^{3}} = 15.92$$

$$\frac{V_o}{V_i} = 95.4\%$$

EE 463 21/11/2017

S.C (1 → 5V)

$1 = 0.09666\,M + \text{offset} \longrightarrow$ ①

$5 = 0.241659\,M + \text{offset} \longrightarrow$ ②

$4 = 0.338319\,M$

$M = 11.82$

$\text{offset} = (5) - (0.241659 \times 11.82) = 2.14$

~~$V_o = 11.82\,V_i + \text{offset}$~~

$V_o = 11.82\,V_i + 2.14$

~~$V_o = V_i$~~ $V_o = 11.82\,(V_i + 0.18V)$

S.C to (0 → 10V)

$0 = M + \text{offset}$

$10 = 5M + \text{offset}$

$10 = 4M \Rightarrow M = 2.5$

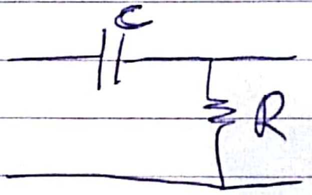
$\text{offset} = -2.5$

$V_o = 2.5V_i - 2.5 \Rightarrow V_o = 2.5\,(V_i - 1)$

EE463 21/11/2017

EX:: Design signal conditing circuit for the sensor which range (4mV → 250mV) and frequcy 1kHz and the noise signal → 200mV (frequcy 60Hz) choose the proper filter for ADC req (0 → 10)

$$\frac{V_o}{V_i} = \frac{F_N/f_c}{\sqrt{1+\left(\frac{f_N}{f_c}\right)^2}}$$ for H.P.F



H.P.F

$$f_c = \frac{1}{2\pi RC}$$

n89

Ans:- Assume $\frac{V_o}{V_i}$ = for noise 10%

$$\frac{10}{100} = \frac{60/f_c}{\sqrt{1+\left(\frac{60}{f_c}\right)^2}} = f_c = 596.\,Hz$$

(تأثير على الاشارة الاصلية)

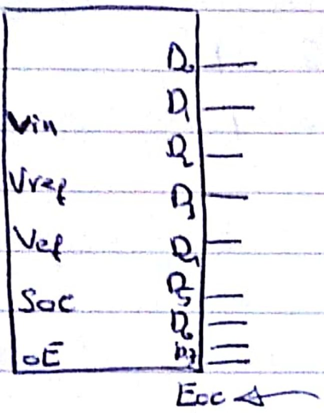
$$\frac{V_o}{V_i} = \frac{\frac{1000}{597}}{\sqrt{1+\left(\frac{1000}{597}\right)^2}} = 85\%$$

if attenuation for signal 30%

$f_c = 190.78\,Hz$

$$\frac{V_o}{V_i} = \frac{\frac{1000}{190.78}}{\sqrt{1+\left(\frac{1000}{190.78}\right)^2}} = \boxed{98\% \Rightarrow 98.22}$$

EE463 — 4-12-2017



نهاية عملية التحويل. End of conversion.

V_{ref}^{+}, V_{ref}^{-}] يحدد ونوع قطبية المحول.

Unipoler ⇒ أحادي القطبية. (0 → 5V). (0 → 5-)

biplorer ⇒ ثنائي القطبية (($\boxed{5V \pm}$)).

SoC → أمر بداية التحويل

output enable : امر اظهار

$$\frac{10}{4} = 2.5$$

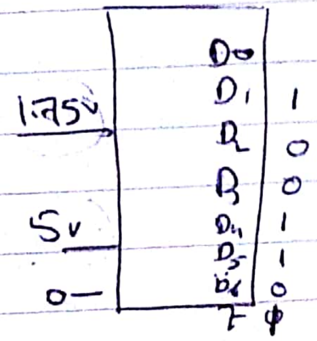
$$\Rightarrow \% \Delta V = \frac{10}{2^n} = \cancel{5} \quad \Rightarrow n \Rightarrow$$ عدد المخارج

resolution ⇒ أقل قيمة يستشعرها المحول

⇒ الاشارة

$$\text{الخرج الرقمي} = \frac{\text{الدخل التناظري}}{\Delta V}$$

EE463 9-12/2017


1.75v
5v
0
D0
D1
D2
D3
D4
D5
D6
7
1
0
0
1
1
0
φ

64 $\overset{32}{}$ 16 8 4 2 1

1 0 1 1 0 0 1 ✓

Ex:- What is the Volt

$$\Delta V = \frac{5}{2^8} = \frac{5}{\boxed{256}} = 19.531\ mV$$

=> كل ما يحصل 19.531 يغير بمقدار واحد.

$$\text{ollDers} = \frac{1.75}{19.531} = 89.609 \simeq \boxed{90}$$

EE 462 7.12.2017

Ex:-

Using pressure sensor which sensitivity $\boxed{13\text{ mV/bar}}$ designe S.C Circuit to connect it to ADC which Voltage refrence $\underline{[0 \rightarrow 5]}$ 8 bit (Sensor) P, rang $\underline{(0 \rightarrow 30\text{bar})}$

what is the ADC output at 10 bar.

Solution: $(0 \longrightarrow 13 \times 30)$

$(0 \longrightarrow 390\text{ mV})$

$0 = 0M + \text{offset} \Rightarrow \text{offset} = 0$

$5 = 0.39m \Rightarrow m = \boxed{12.82}$

$V_o = V_i\, 12.82$

V_i	0	0.195	0.39
V_o	0	2.5	5

$$\Delta V = \frac{5-0}{2^8} = \frac{5}{250} = \boxed{19.53125\text{ mV}} \leftarrow$$

B) Sensor output at 10 bar $\Rightarrow \underline{10 \times 13\text{ mV}} = \boxed{130\text{ mV}}$

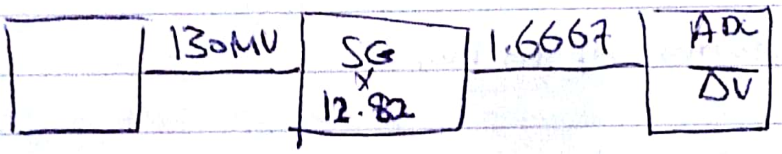
Ω = at

EE463 7-12-2017

ADC output = $\frac{\text{Analog input}}{\Delta V} = \frac{1.6667}{19.53} = 85.35$

$= 85$

01010101



Ex:-

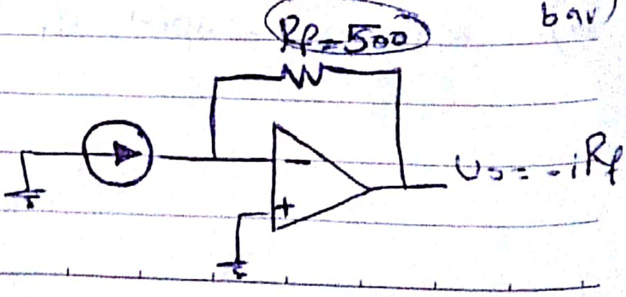
Using pressure sensor which sensitivity $\boxed{0.24 MA/bar}$ in the range 0 → 10 bar and it's input @ ϕ bar, 12MA Design S.C circuit to connect it to ADC 8 bit which refrence (0 → 6V).

What is the ADC output (5.5 bar).

(range sensor):-

$(0 \rightarrow 10\times0.24MA) \overset{at}{=} 12MA \rightarrow \overset{m}{12MA} + (10 \times 0.24 \frac{MA}{bar})$

$\Rightarrow (12MA \rightarrow 14.4MA)$



EE463 7-12-2017

$12mA \times 500 = 6V$
$14.2mA \times 500 = 7.2V$

$Rang(V) = (6 \rightarrow 7.2)V$ [ليش قسمة على 2]

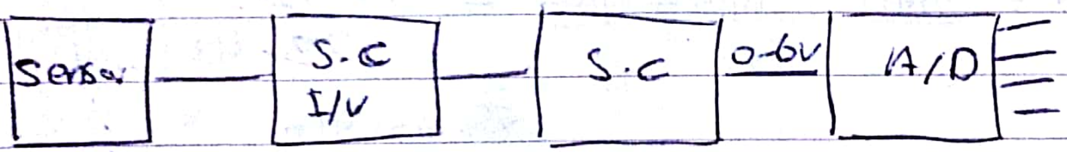
$0 = 6M + offset$

$6 = 7.2M + offset$

$6 = 1.2M \Rightarrow M = \frac{6}{1.2} = \boxed{5}$ $offset = -30$

$V_o = 5V_i - 30$

$V_o = 5(V_i - 6)$



$\Delta V = \frac{6-0}{2^8} = \boxed{0.0234375}$

at 5.5 bar $5.5 \times 0.24 \times 12 = 13.32 mA$

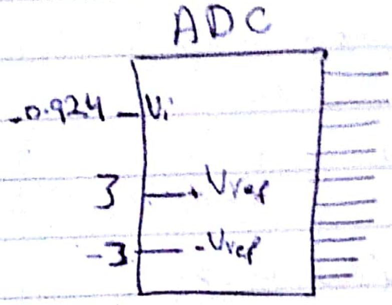
$-(13.32\ mA \times 0.5k) = -6.66V$

$V_o = 5(6.66 - 6) = 3.3V$

$digital\ output = \frac{3.3}{23.4375} = 140$, 10001100

EE463 7-12-2017

Ex:: What is the digital output of the following



$\Delta V = \frac{V_{ref}(+) - V_{ref}(-)}{2^n} = \frac{6}{256} = 23.4875 \text{ MV}$

$\text{Dig output} = \frac{\text{Analog input} + V_{ref}}{\Delta V} = \frac{-0.924 + 3}{23.4375 \text{ MV}}$

$88 = 01011000$

$\Delta V = \frac{8}{2^8} = 0.03125$

Digital output = 170.24 = 170 = 1010101

S.

EE462 11/12/2017

Using an Acceleration which sensitivity ±20g (10MV/g)

Design circuit for ADC which refrence ±5V (8 bit)

& which is output of ADC at +3g & −7g

Sensor rang (−200MV − 200M)

$-5 = -200MV + offset$

$5 = 200MV + offset$

$10 = 400MV \Rightarrow M = \frac{10 \times 1000}{400} = 25$

$V_o = V_i * 25$

Digital output at 3g

$\Delta V = \frac{5-(-5)}{2^8} = \frac{10}{2^8} = \frac{10}{256} = 39.0625\ MV.$

جيت منين

$$\text{Digital output} = \frac{\text{Analog output} + V_{ref(+)}}{\Delta V} = \frac{\boxed{0.75}+5}{39.0625 \times 10^{-3}}$$

$|147.2| = 147 = (10010011)_2$

93

$(3g \times 10\ MV/g)(25)$

$(0.03)(25) = \boxed{0.75}$

EE463 11/12/2017

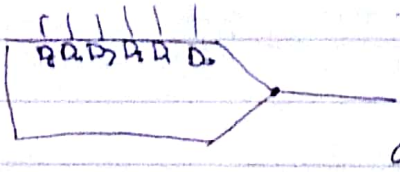
Sensor output

at -7g = -70mV

Analog input = .70×25 = 1.75V

Digital output = $\frac{-1.75+5}{39.0625\times163}$

(83) = 01010011



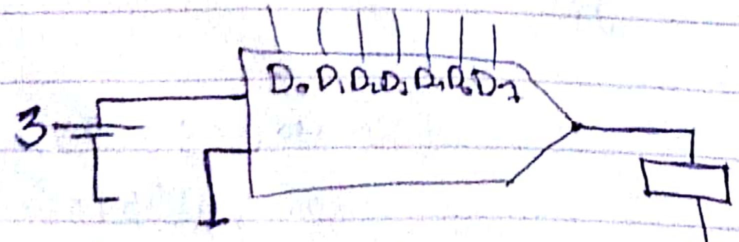
$\Delta V = \frac{V_{ref}}{2^n} = \frac{3}{2^8} = 0.0117$

(resolution) ← أقل قيمة يشعر بها المحول.

المخرج التماثلي . المدخل الرقمي

Analog output = Digital input Value × ΔV

EX:- what is the analog output value of the following ADC



10100011 , 163 × 0.01171875 = 191V

EE 463 11/12/2017

what is the output Volt of (10 bit) DAC unipolar 10v ref

if the input is A = 0B5H

B = 20FH .

what is the input needed to get 6.5V (o/p)

$\Delta V = \frac{10}{2^{10}} = \frac{10}{1024} = 9.765 mV$

Analog output = Dig input $\times \Delta V = 527 \times 9.765 \times 10^{3} = 5.14V$

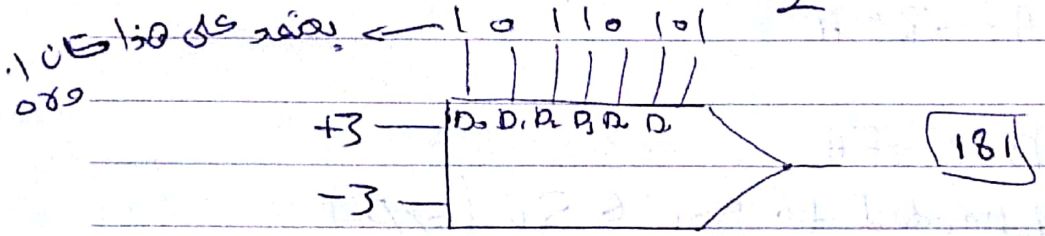
0B5 H

0010110101 → 181 X

EE463 14-12-2017

* bipoler example:-

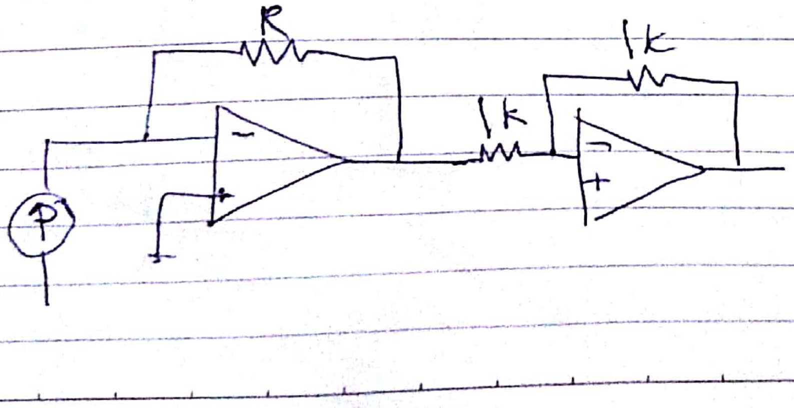
$V_o = (\text{Digital input} * \Delta V) - \frac{V_{ref}}{2}$


1 0 1 1 0 1 0 1
بنحوله كدا هتطلع ١٨١
+3
-3
D0 D1 D2 D3 D4 D5
181

$V_o = \underline{181} * 23.4375 \times 10^{-3} - 3 = 1.24V$

$\Delta V = \frac{3-(-3)}{2^8} = \frac{6}{2^8} = 23.4373\ mV$

Ex:- Using Temp sensor which sensitivty 0.3MA/C° & pressar sensor which sensity 4.2 MV/bar design circuit which oprate fan at temp is 35C° and opras value. if Pressure is More than 12 bar and oprate. alarm if both are High and green Led if both are law.



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designed point

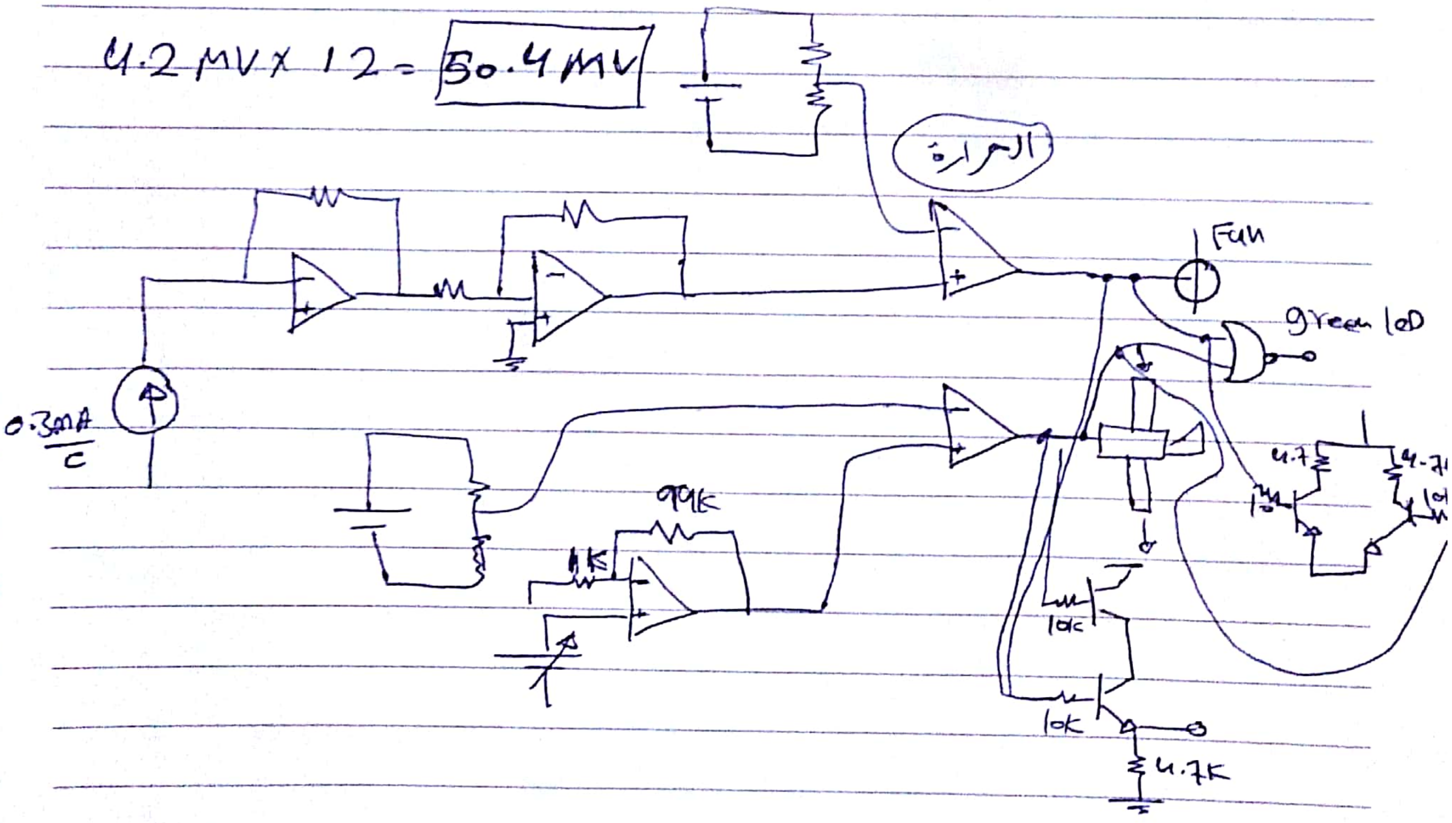
Sensor maximum rang = 0.3MA x 35 = 10.5 MA

Using R = 500

Sensor output = 10.5 MA x 500 = 5.25 V

Pressure output at designed point:-

4.2 MV x 12 = $\boxed{50.4 MV}$


الحرارة
Fan
green LED
0.3mA/C
99K
1K
4.7
4.7
10
10
10K
10K
4.7K